View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by KITopen

Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 31 (2019) 38–44

Procedia MANUFACTURING

www.elsevier.com/locate/procedia

9th Conference on Learning Factories 2019

Development of a training concept for leadership 4.0 in production environments

Sina Helming[a,]*, Florian Ungermann[a], Natalie Hierath[a], Nicole Stricker[a], Gisela Lanza[a]

[a]*wbk Institute of Production Science, Karlsruhe Institute of Technology (KIT), Kaiserstraße 12, 76131 Karlsruhe, Germany*

Abstract

Industry 4.0 and the associated technological change result in far-reaching modifications not only having an impact on a company's organization, but also on the people within it. Managers thereby play a crucial role as they form one major component of a successful change process. Hence, the presented Leadership 4.0 training concept was developed in order to further qualify and sensitize managers for new forms of leadership in the era of Industry 4.0. The training module allows production managers to understand how leadership changes through Industry 4.0 and which specific aspects should be taken into consideration, especially with respect to employee management. In contrast to existing leadership trainings, the presented training especially focuses on production environments and is therefore primarily carried out within the wbk Learning Factory on Global Production. This way, changes resulting from digitization and Industry 4.0 can be vividly experienced and transferred to the managers' day-to-day work.

© 2019 The Authors. Published by Elsevier B.V.
Peer review under the responsibility of the scientific committee of the 9th Conference on Learning Factories.

Keywords: Leadership; Industry 4.0; Change Management; Production Systems

1. Introduction

In recent years, Industry 4.0 has been introduced to allow for a more efficient production, especially on shopfloor level [1]. The shift towards digitalised production thereby does not only involve technological progress and empowerment, but particularly requires the target-oriented qualification of personnel [2]. In this context, employee management and leadership play an important role – a fact that is also reflected in a study conducted by [3] where 70% of the participants affirmed that leadership would change in the context of Industry 4.0. Challenges faced by managers as a result of Industry 4.0 and digital transformation thereby especially include the management of change,

* Corresponding author. Tel.: +49-721-608-44297; fax: +49-721-608-45005.
E-mail address: sina.helming@kit.edu

2351-9789 © 2019 The Authors. Published by Elsevier B.V.
Peer review under the responsibility of the scientific committee of the 9th Conference on Learning Factories.
10.1016/j.promfg.2019.03.007

the adaptation of structures and the creation of acceptance among employees [4]. The entire process of transformation to Industry 4.0 depends on the management's adaptation of leadership to the era of Industry 4.0 – a phenomenon which is often referred to as leadership 4.0 [5]. In order to allow for a transformation towards leadership 4.0, managers must be explicitly qualified and promoted in production to be prepared for such challenges. As a result, the training "Leadership 4.0 in a Production Environment" has been developed. The concept contributes to the understanding of the interdependencies between Industry 4.0 and leadership and enables the development of necessary competencies that can be transferred to everyday production. The target group of this training are production managers who are in charge of shop floor workers and who already had a first contact with the technical implications of Industry 4.0. It is not about showing how to design the technical change to Industry 4.0 in a company, but how production managers have to adapt their leadership style in a given Industry 4.0 environment. To allow the participants to experience challenges in production related with Industry 4.0 as realistically as possible and to transfer their insights into their own production environment, the Learning Factory on Global Production (LGP) of the Karlsruhe Institute of Technology (KIT) is included in the development of the training concept. By involving new technologies, it offers the possibility to demonstrate and experience the connections between Industry 4.0 and leadership and to create awareness of the transformation taking place and the need for rethinking.

2. Fundamentals and State of the Art

In line with [1], Industry 4.0 covers the entire value-adding process with a focus on production. By connecting people, objects and systems, cyber-physical production systems (CPPS) are created that allow higher individualization, flexibility and increased productivity. To realize CPPS from a management point of view, agile organizations and a flexible working environment is necessary. Such a transformation must be designed together with the employees, but managers should trigger it. [6] shows that an active shaping of digital cultural change by company management is one of the most important success factors. Leaders should communicate a clear vision and strategy and thus trigger innovation. Nevertheless, a creative environment should be implemented in which employees develop and convert their ideas into practice. This requires a suitably adopted leadership, whereby leadership generally describes "[The] ability to give a direction, to influence others in the sense of a common goal, to motivate and bring them to action and to take responsibility for their performance" [7]. According to the leadership model developed by [8], leadership includes a leadership personality (person of the leader) and employees as well as the direction in which leaders influence employees (leadership behavior). All three aspects are influenced by the leadership situation which describes the environment in terms of organizational structure, group size, etc. (see Fig. 1). Hence, there are neither the right leadership qualities nor the optimal leadership behavior. The demands and challenges placed on managers are always situation-specific [8]. As Industry 4.0 can be seen as part of the "leadership situation", the relevance of adjusting leadership behavior to the changing requirements induced by Industry 4.0 becomes indispensable.

Existing leadership 4.0 training concepts justified by the technological change induced by Industry 4.0 are shown in Table 1. They are compared according to five criteria: On the one hand, the criteria refer to the fact that the training should focus on Industry 4.0 in a real production environment. On the other hand, didactical criteria are involved which allow for a more detailed impression of the training structure in terms of used methods, interactivity, and practicability. Hence, the criteria are: Industry 4.0, production environment, level of detail, interactive elements, and practical approach. As can be seen in Table 1, only some of the existing training concepts consider Industry 4.0 as an essential aspect in the training while the majority of trainings is only motivated by Industry 4.0.

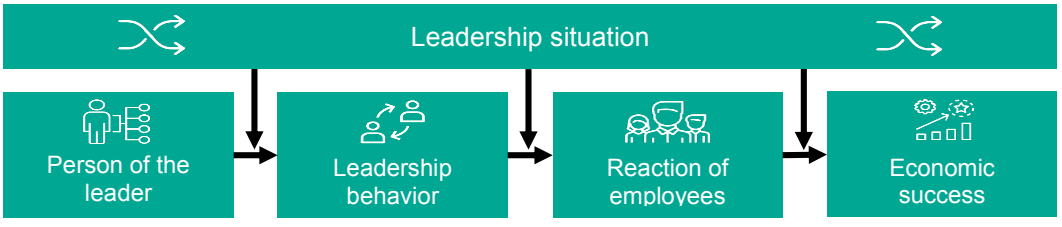


Fig. 1. Leadership model reflecting the interdependencies between leaders and employees according to [8].

Table 1. Current state of the art of leadership 4.0 training concepts (D: design principles, M: methods).

Training	Industry 4.0	Production environment	Level of detail	Interactive elements	Practical approach
Bavarian Business Education Forum [9]	×	×	D/M	✓	×
Euroforum [10]	✓	×	D/M	✓	×
Academy for Managers [11]	×	×	D/M	✓	×
Association of German Engineers [12]	×	×	D/M	✓	×
Forum for Managers [13]	✓	×	D	✓	×
Consulting Excellence [14]	✓	×	D/M	✓	×
Medium-sized companies 4.0-competence center Hamburg [15]	×	×	×	×	×
Medium-sized companies 4.0-competence center Communication [16]	×	×	D/M	×	×

A demonstrator for real production environments has not been included in existing trainings. Similarly, an approach which gives the participants the chance to independently identify solutions by means of practical experimentation has not been implemented. Nevertheless, existing trainings have put a lot of emphasis on involving the participants by using interactive elements. The evaluated concepts have a similar level of detail. Mostly, design principles (D) that represent superordinate principles and concepts, and methods (M) that are concrete tools which are necessary for the implementation of the design principles, are part of the training. In summary, however, none of the evaluated concepts include all five defined criteria.

3. Development of a training concept for Leadership 4.0 in a production environment

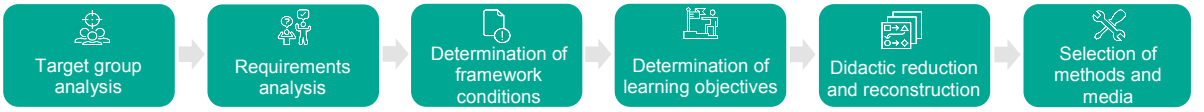
3.1. Methodology for training development

In order to ensure a logically structured and goal-oriented workshop, a dedicated methodology is being used. The methodology is adapted from the six-step model for seminar development by Quilling and Nicolini [17] and complemented by concepts by Tietgens [18] and Bonz [19]. Therefore, the resulting methodology is composed of six steps (see Fig. 2) which are partially described in more detail in the following. As the training concept has especially been developed for (future) production managers that will lead or have already led employees working on the shopfloor, the target group (step 1) has already been determined at the beginning of the concept development. The same applies for the framework conditions (step 3): The LGP which consists of a real-world production line for manual assembly of electronic motors has explicitly been chosen as major learning environment. As the didactic reduction and reconstruction is a rather theoretic approach which aims at selecting relevant information and putting them in a logical order (see [18]), it is also not explained in more detail in chapter 3.1. Its result – the overall training procedure – however, will be detailed in chapter 3.2 Thus, the steps of analyzing the requirements (step 2), determining learning objectives (step 4), and selecting suitable methods (step 6) will be explained in the following.

Requirements analysis

The requirements analysis reveals which competences are to be taught during the training in order to allow the participants to be prepared for an era in which leadership is changing due to Industry 4.0. Besides a basic understanding of Industry 4.0 technology and leadership as an expected precondition, the necessary competencies can be clustered in three interdependent dimensions: communication, transparency and structure [1]. These clusters are explained in the following.

- Communication: Digitisation and networking go hand in hand with spatially and temporally dispersed structures. Virtual leadership by means of digital communication is increasingly required [3],[4]. On the one hand, virtual



leadership might result in a better work-life balance and a complete information base, but on the other hand it also

Fig. 2. Methodology for concept development for the Leadership 4.0 in a production environment training adapted from [17], [18] and [19].

leads to a lack of direct communication and hence to a lack of trust and appreciation whereas direct communication creates and promotes team spirit [20],[21].

- When making use of digital communication possibilities, attention must therefore be paid to a target-oriented and meaningful communication since the agility and openness that it often entails can also lead to chaos and unnecessary data exchange.
- Transparency: To ensure employee motivation, it is a challenge for managers to ensure sufficient transparency of overall production and the distribution of tasks. Due to the increasing complexity, target definitions are becoming increasingly opaque [22],[23]. By increasing transparency, employees can be significantly more involved and the exploitation of their potentials and competencies can be improved.
- Structure: To support the agility that is required in a dynamic environment with large product varieties, the organizational structure must become more flexible [22]. To achieve this, flatter hierarchies and situational decision-making must be introduced to allow for short communication channels, the reduction of distance between managers and employees as well as for building trust relationships and establishing an esteem culture [1],[21].

Determination of learning objectives

Building upon the previous steps, suitable learning objectives are subsequently derived. The definition of learning objectives is thereby based on the guidelines for formulating qualification objectives of the KIT. As shown in Fig. 3, three overall objectives as well as respective sub-objectives have been formulated. The first learning objective thereby focuses on the definition of Industry 4.0 and on the explanation of the possibilities the LGP provides for experiencing Industry 4.0. As a second learning objective, the participants experience working in a production environment in general and in a production environment opposed to changing conditions in particular. The focus thereby especially lies on the challenges (referring to transparency, communication and structure) and risks for leadership induced by Industry 4.0. Based upon the participants' experiences on working in such a dynamic production environment, the third learning objective combines leadership with the requirements of Industry 4.0 and seeks to elaborate solutions for the participants that can be transferred to their real use cases related to transparency, communication, and structure.

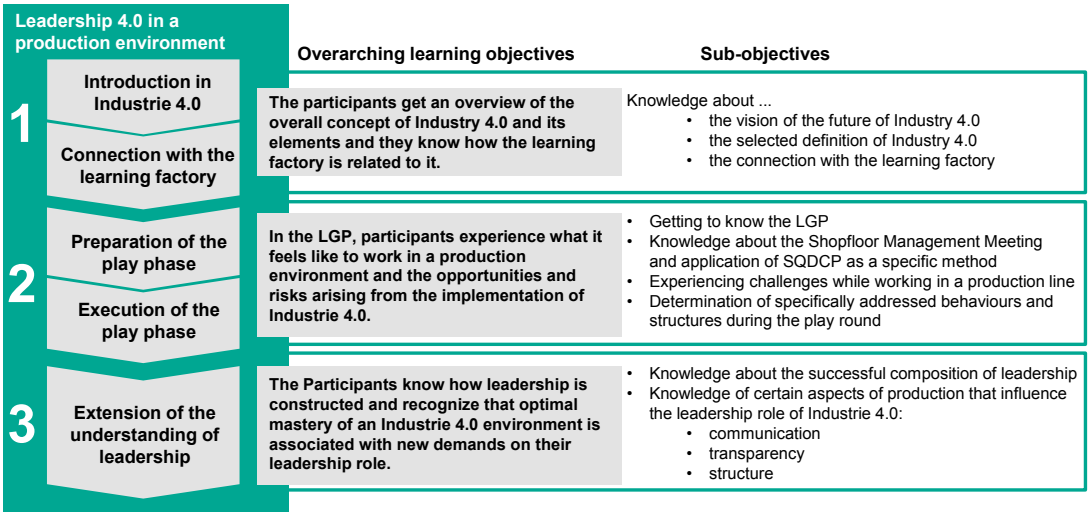


Fig. 3. Learning objectives and didactical phases.

Selection of suitable methods and media

As a further step of the methodology, suitable didactical methods are selected in order to support achieving the defined learning objectives. The approach of selecting suitable methods thereby grounds on the systematic of methodological decisions proposed by Bonz [19]. Resulting from the fact that the LGP is used as a hands-on learning environment where the focus lies on practically experiencing working in an Industry 4.0 production environment, role play is the overarching method of the training. The role play can thereby by divided into the following five superordinate phases: Information phase, preparation phase, play phase, discussion/reflection phase, and generalization/transfer phase. While the information phase is mainly addressed by lectures, the preparation phase uses informing and practicing as overall methods. Suitable methods for the generalization or the discussion phase are the world café method or group works and discussions in general. The play phase is supported by the observation sheets, by actually experiencing the learning factory and by means of the SQCDP method. SQCDP thereby stands for "safety", "quality", "cost", "delivery", and "people" and is used as a structured and target-oriented approach for conducting a shopfloor management meeting. Fig. 4 illustrates the respective methods for the whole training procedure.

3.2. Description of training procedure

The application of the previously described methodology results in the following course of training. As outlined in Fig. 4, the training starts with an introduction to Industry 4.0 and its technological possibilities in order to ensure that all participants have a common understanding of the topic. After this lecture part, participants are divided into two groups. While one group starts with a theoretical input on shopfloor management and dedicated observation methods, the other group gets familiar with the production environment in the LGP by conducting a test run. The reason for subdividing the group is that the participants are observed by their counterparts during the active play round. Therefore, the observation methods are introduced before, so that all participants are able to observe the occurrences in the play round in a structured way. When all participants have run through both phases, the first play round takes place. Here, one group (shadow team) observes the behavior of the other group which is running the production line in different roles (e.g. worker, logistician, area manager, plant manager) with the help of the introduced observation methods. During the play round, the active players will be supported by different Industry 4.0 technologies available in the LGP. Among others, these include a smart camera for in-process quality assurance, smart glasses for visualizing assembly instructions, a robot for human-machine collaborations and a web-based messaging service that allows communication flows between individuals or groups in the production environment. The usage of such technologies induces a changed leadership relationship between managers and employees as communication might more and more take place virtually instead of personally. In order to create awareness for the necessity to change leadership behavior, different scenarios are included in the play rounds which animate participants to rethink classical leadership structures. The scenarios thereby illustrate challenges that occur in an Industry 4.0 production environment (learning objective 2) and draw the participants' attention to the previously introduced dimensions of communication, transparency and structure (see 3.1).

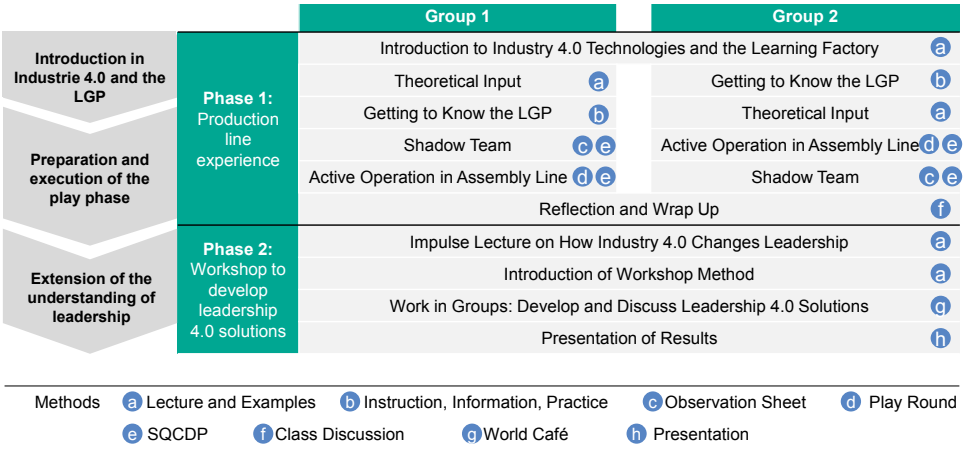


Fig. 4. Final training procedure resulting from the didactic reduction and reconstruction with suitable methods.

To exemplify this, one of these scenarios is now presented in more detail: A situation is artificially created in which participants are only allowed to communicate with each other via a group chat during the game round. At the same time, errors occur at the individual assembly stations that cannot be solved by the employees themselves and therefore require input from the team leader. Consequently, the employee whose station is affected by an error writes a message in the group chat and waits for the team leader to come and solve the problem. Since several errors can occur simultaneously, the chat quickly becomes intransparent and the team leader might lose control. Due to the information overload, the team leader might particularly overlook urgent errors in the group chat and solve unimportant problems instead. The scenario is intended to sensitize the participants to the fact that communication channels might change in an Industry 4.0 age and that the form of communication must be well chosen. Besides, the scenario draws the participants' attention to the importance of transparency and prioritization. The observers are asked to document the reactions of the employees by means of specific questions about unexpected events. The key takeaway from situations like the presented one is that they intend to animate the participants to rethink existing leadership structures and to sensitize them for the importance of carefully developing new leadership structures.

As in a real production environment, a shopfloor management meeting is also included in the play round. During the meeting, the participants are asked to share their experiences by means of the SQCDP method. In order to allow all participants to experience a play round in the LGP, the roles are changed and the procedure is repeated. While the first phase focused on experiencing the necessity to change leadership because of an Industry 4.0 environment, the second phase aims to develop and discuss Leadership 4.0 solutions within a workshop. First, the participants are asked to share their experiences from phase 1 and their expectations regarding an ideal leadership 4.0 by picking suitable phrases related to the topic. This activates the participants for the creative part of the training. In order to actively integrate all participants in defining Leadership 4.0 solutions, the World Café method is applied. Therefore, three groups are built and each group starts to elaborate potential leadership 4.0 solutions for the problems which have been experienced during the play rounds and systematically identified during the reflection session. Each group focusses on one of the categories communication, transparency and structure. By rotating, the participants work on solutions for all of the dimensions and share their practical approaches for dealing with similar problems in their company. This way, the exchange of experiences is fostered. After a short break, the results are presented to the plenum and the training is finished with a brief conclusion.

4. Conclusion and Outlook

Industry 4.0 and the digital transformation offer a multitude of potentials for increasing efficiency and improving processes in production and assembly. Managers play a particularly important role on the way to Industry 4.0 as they act as role models: Only if they support the change, the employees will pull along and help the company to proceed in terms of Industry 4.0. To be able to support the change, managers must develop new leadership 4.0 competencies being in line with the digital transformation. Therefore, this paper has proposed a training concept which aims at sensitizing actual and prospective managers for the changes in leadership caused by Industry 4.0. The training concept promotes the qualification of the participants with regard to leadership competencies and provides specific methods and tools which support transferability to the participants' everyday work. The inclusion of the LGP of the wbk Institute of Production Science at the KIT thereby actively fosters practicability.

References

[1] W. Goschy, T. Rohrbach, Industrie 4.0: Deutscher Industrie 4.0 Index 2017. https://www.staufen.ag/fileadmin/HQ/02-Company/05-Media/2-Studies/STAUFEN.-studie-deutscher-industrie-4.0-index-2017-de_DE.pdf, 2017 (accessed 8 November 2018).

[2] A. Hildebrandt, W. Landhäußer (Eds.), CSR und Digitalisierung: Der digitale Wandel als Chance und Herausforderung für Wirtschaft und Gesellschaft, Springer Gabler, Berlin, Heidelberg, 2017.

[3] S. Niedermeier, Industrie 4.0 = Führung 4.0: Warum sich Führung verändern muss?. https://www.bbw-seminare.de/fileadmin/user_upload/Seiten/Weiterbildung/Digitalisierung_Industrie_40/Industrie_40/Studie-Industrie_40_Fuehrung_40/Studie-Industrie-40-Fuehrung-40.pdf, 2016 (accessed 8 November 2018).

[4] BSP Business School Berlin GmbH, Leitlinien für Führungskräfte in Zeiten des digitalen Wandels: E-Leadership. http://mittelstand-digital.de/MD/Redaktion/DE/PDF/leitfaden-eleadership,property=pdf,bereich=md,sprache=de,rwb=true.pdf, 2017 (accessed 8 November

2018).
[5] D. Kudernatsch, H. Rotter, Shopfloor Management: Schaffung einer langfristig erfolgreichen Unternehmenskultur. https://www.awf.de/wp-content/uploads/2017/01/2017_01_17_Doku_AK_SFM.pdf, 2012 (accessed 8 November 2018).
[6] D. Schaefer, U. Bohn, C. Crummenerl, Culture First! Von den Vorreitern des digitalen Wandels lernen, Change Management Studie 2017, Capgemini Consulting, 2017. https://www.capgemini.com/consulting-de/wp-content/uploads/sites/32/2017/10/change-management-studie-2017-capgemini-consulting.pdf (accessed 8 November 2018).
[7] G. Hölzerkopf, Führung auf den Punkt gebracht: Praktische Handreichungen und Empfehlungen, first ed., Gabler Verlag, Wiesbaden, 2005.
[8] L. von Rosenstiel, E. Regnet, M. Domsch, Führung von Mitarbeitern: Handbuch für erfolgreiches Personalmanagement, seventh ed., Schäffer-Poeschel Verlag, Stuttgart, 2014.
[9] E. Wailand, Führung 4.0. https://www.bbw-seminare.de/weiterbildung/digitalisierung-industrie-40/fuehrung-40/, 2018 (accessed 8 November 2018).
[10] Euroform Deutschland GmbH, Führung 4.0. http://www.euroforum.de/veranstaltungen/fuehrung_4-0_november2018/programm, 2018 (accessed 8 November 2018).
[11] Akademie für Führungskräfte der Wirtschaft GmbH, Intensivworkshop Führung für Nachwuchs-Führungskräfte. https://www.die-akademie.de/seminare/intensivworkshop-fuehrung-nachwuchs-fuehrungskraefte, 2018 (accessed 8 November 2018).
[12] VDI Wissensforum GmbH, Exzellent führen. https://www.vdi-wissensforum.de/weiterbildung-fuehrungskraefte/exzellent-fuehren/#seminarmethoden, 2018 (accessed 8 November 2018).
[13] Forum für Führungskräfte, Leadership 4.0. https://www.fff-online.com/themenuebersicht/fuehrung-kommunikation/seminar/leadership-40.html, 2018 (accessed 8 November 2018).
[14] Consulting Excellence, Führung 4.0 Seminar. https://consultingexcellence.de/seminare/fuehrungskraeftetraining/fuehrung-4-0-seminar/, 2018 (accessed 8 November 2018).
[15] Bundesministerium für Wirtschaft und Energie Referat Öffentlichkeitsarbeit, Mittelstand 4.0-Kompetenzzentrum Hamburg. http://www.mittelstand-digital.de/DE/Foerderinitiativen/Mittelstand-4-0/kompetenzzentrum-hamburg,did=750646.html, 2018 (accessed 8 November 2018).
[16] BSP Business School Berlin Hochschule für Management, Workshop Transitionsmodell: Mitarbeiterführung im digitalen Wandel. http://mittelstand-digital.de/MD/Redaktion/DE/PDF/agentur.kommunikation-angebotskarte-transitionsmodell,property=pdf,bereich=md,sprache=de,rwb=true.pdf, 2016 (accessed 8 November 2018).
[17] E. Quilling, H. Nicolini, Erfolgreiche Seminargestaltung: Strategien und Methoden in der Erwachsenenbildung, second ed., VS Verlag für Sozialwissenschaften, Wiesbaden, 2009.
[18] H. Tietgens (Ed.), Didaktische Dimensionen der Erwachsenenbildung, Pädagogische Arbeitsstelle des Deutschen Volkshochschul-Verbands, Frankfurt am Main, 1991.
[19] B. Bonz, Methoden der Berufsbildung: Ein Lehrbuch, second ed., Hirzel Verlag, Stuttgart, 2009.
[20] S. Franken, Führungskompetenzen für Industrie 4.0, Industrie 4.0 Management 32 (2016) 55–57.
[21] ZHAW Zürcher Hochschule für Angewandte Wissenschaften, IAP Studie 2017: Der Mensch in der Arbeitswelt 4.0. https://www.zhaw.ch/storage/psychologie/upload/iap/studie/IAP_STUDIE_2017_final.pdf, 2017 (accessed 8 November 2018).
[22] A. Korge, Agile Organisation und Führung 4.0, Zeitschrift für wirtschaftlichen Fabrikbetrieb 112 (2017) 289–292.
[23] Hays, HR-Report 2014/2015 Schwerpunkt Führung: Eine empirische Studie des Instituts für Beschäftigung und Employability IBE im Auftrag von Hays für Deutschland, Österreich und Schweiz. http://www.ibe-ludwigshafen.de/download/arbeitsschwerpunkte-downloads/trends-der-arbeitswelt-downloads/HR-Report-2014-2015_Fuehrung_2.pdf, 2014 (accessed 8 November 2018).